

## **The Chernobyl Incident—Experiences, Recovery and Lessons Learned**

Ideas for Alternate titles:

Recovering from a Radiological Terrorist Attack—Lessons Learned from the Chernobyl Incident

Nuclear Terrorism—What Can We Expect? Experiences, Recovery and Lessons Learned from the Chernobyl Incident

Recovering from a Nuclear Terrorist Attack—What We Can Learn from the Chernobyl Accident

### **1. Introduction**

In an age in which terrorist attacks are becoming more frequent and more lethal, an attack on the United States that releases radiation—the explosion of a “dirty bomb” or improvised nuclear device—is a frightening and very real threat. Such a radiological assault would aim to inflict mass casualties, widespread panic and disruption, and could cause contamination that lasts for months or even years after the initial event.

U.S. government agencies at the state, local and federal levels are preparing for such an event and have been rehearsing the emergency responses that would occur immediately after such an attack. But how would we cope with the aftermath of the event? What could we do to recover from its longer-term consequences?

The long-term recovery lessons learned from the 1986 Chernobyl nuclear plant disaster help to answer these questions. The Soviet response to that disaster and the analyses that followed give us insights into what does and doesn’t work in responding to such a situation. In this film, we will examine the basics of what a radiological attack on the United States would involve, and what the countermeasures and restoration actions taken after the Chernobyl accident tell us about what we might expect following such an event. We will enhance our discussion with the first-hand, personal perspectives of an early responder who provided technical assistance during the first phases of the recovery from Chernobyl, and of a resident of Kiev who was a young mother in Ukraine at the time of the disaster.

Dr. John Cardarelli, an Industrial Hygienist and Health Physicist with the U.S. Environmental Protection Agency explains why it is useful to focus on Chernobyl:

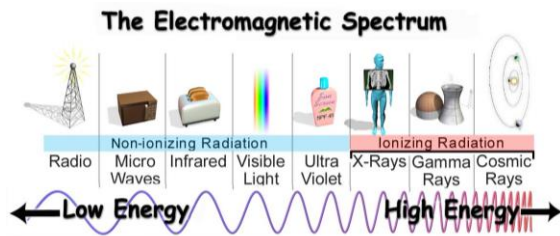
*[Image: JC1 5:00:50 – 5:01:24 “Chernobyl brings us a unique perspective in the fact that it was uh, uh, a real, live situation where hundreds of thousands of square kilometers*

*were contaminated with radioactive material that had been um, dispersed from the reactor accident. And it exposed hundreds of thousands of humans, requiring a large amount of environmental clean up. So what we can learn from those aspects and apply them here in the United States could be very valuable if we were to ever experience something similar to that here in the United States.”]*

By improving public awareness and helping people to educate themselves on the issues associated with a possible radiological emergency, we will not only be better prepared, but the power of such an event to terrorize our citizens can be greatly reduced.

## 2. Radiation and Radioactivity

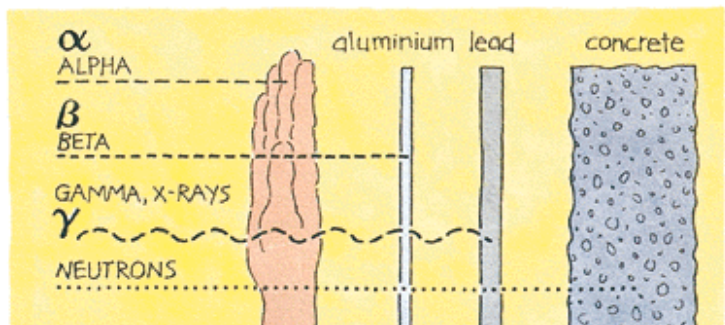
In order to more fully understand the effects of a radiological emergency and the long-term recovery issues associated with it, we will first review some of the basic concepts and terms about radiation and radioactivity.



All of us are continuously exposed to radiation from both natural and man-made sources. For example, natural background radiation varies throughout the world and its level depends on many factors such as altitude, soil conditions and location on earth. The word “radiation” has many meanings, and there are many types of radiation. [Graphic—*electromagnetic spectrum*] Television and radio waves, radar and visible light are all examples of radiation, and none of these cause harm to living organisms under normal conditions. These lower-energy types of radiation are called “non-ionizing radiation.”

The other general category of radiation is called “ionizing radiation.” Ionizing radiation is higher in energy than non-ionizing radiation and can damage living cells. It comes from radioactive materials, including naturally occurring radioactive elements found on earth, cosmic rays from space and man-made radiation sources such as medical x-rays. The level of radiation from naturally occurring sources to which we are exposed on a daily basis is called “background radiation,” and it varies throughout the world depending on such factors as altitude, soil conditions and location on earth.

There are four main types of ionizing radiation: alpha particles, beta particles, gamma rays and neutrons.



*[Text and graphic from the REMM Video 1 min 33 sec:]*

*“Alpha particles may be ejected from the nucleus of an atom during radioactive decay. They are relatively heavy and only travel about an inch in air. Alpha particles can easily be shielded by a single sheet of paper, and cannot penetrate the outer dead layer of skin, so they pose no danger when their source is outside the human body.*

*Beta particles are essentially electrons emitted from the nucleus of a radioactive atom. They are lighter than alpha particles, and can travel farther in air, up to several yards. Very energetic beta particles can penetrate up to one half an inch through skin and into the body. They can be shielded with less than an inch of material such as plastic. In the case of lower energy beta particles, the outer layer of clothing can act as an effective shield.*

*Gamma rays can be emitted from the nucleus of an atom during radioactive decay. They are able to travel tens of yards, or more, in air, and can easily penetrate the human body. Shielding this very penetrating type of ionizing radiation requires thick dense material such as several inches of lead or concrete.*

*Neutrons can be released from the nucleus of an atom during a fission reaction, such as within a nuclear reactor, or upon detonation of a nuclear weapon. Neutrons, like gamma rays, are very penetrating, and several feet of concrete is needed to shield against them.*

If radioactive materials are released into the environment as the result a terrorist attack or accident, people could be exposed to higher than background levels of ionizing radiation that could contaminate them and their surroundings. When vaporized radioactive material is released into the atmosphere, it cools, condenses into solid particles, and falls back to earth. These particles can be carried by the wind as a plume, and can contaminate surfaces far from the explosion itself, including food and water supplies. This phenomenon is known as “fallout.”

*[Will use RMM Website video here with narration by our narrator using text below. Text in italics is exactly that from the existing video. Time = 1 min 52 seconds. Additional text not in italics has been added to explain how medical treatment can help.]*

*“When a person is near a source of radiation, some type of radioactive material, he or she can be exposed to the radiation emitted by this source. However, he or she does not become contaminated.*

*One way to think about exposure is to think about X-rays. When a person has a chest X-ray, he or she is exposed to radiation, but does not become contaminated with radioactive material.*

*A person can reduce his or her exposure to radiation, if he or she is shielded in some ways from the radiation, for example, if the person is behind a concrete wall, or if the radioactive source is inside of a lead container.*

*In order to become contaminated, radioactive material must get on the skin, or clothing, or inside of the body. For example, if radioactive material is incorporated into a dirty bomb, a conventional explosive, such as dynamite that has been laced with radioactive material, then people could become contaminated when the device is detonated.*

*Radioactive material on the outside of the body is called external contamination. When a person becomes externally contaminated, simply removing the clothing can remove up to 90% of the contamination. Gently washing the skin and the hair can remove most of the remaining contamination.*

*If a person ingests or inhales radioactive material, it can become incorporated in the organs of the body. This is called internal contamination. When a person is internally contaminated, depending on the type of radioactive material with which they were contaminated, certain medications can be administered to speed up the rate at which the radioactive material is eliminated from the body.”* For example, Prussian Blue is an effective drug that can be used to eliminate Cesium from the body, and was used on animals following the Chernobyl incident so the population could drink animal milk and eat meat. Potassium Iodine tablets were also taken by many people to counter the negative effects of the Iodine-131 gas that was released during the accident.

Once released, radioactive materials remain a threat to the environment for varying periods of time. How quickly a radioactive material decays is measured by its “half-life,” or the amount of time it takes for the radioactivity of the material to decrease by half. For example, the half-life of Cesium-137 is about 30 years. This means that about half of the Cesium-137 released during the Chernobyl accident will have decayed by the year 2016. This decay process will continue, and after 7-10 half-lives, or 210-300 years, the Cesium radioactivity from Chernobyl will have decayed to near background levels. The long half-life of some radioactive elements such as Cesium presents difficult challenges since people may be exposed to a contaminated environment for many years unless action is taken to decontaminate the area affected by the accident.

On the other hand, another radioactive element released at Chernobyl was Iodine-131, which has a half-life of 8 days. This presented a much shorter-term challenge because it decayed away in about 56 to 80 days after the accident.

*[May be good to have a graphic here to help summarize the key points to take away from this section, with simple voice over.]*

To summarize some of the key points about radiation and radioactivity:

- All of us are continuously exposed to low-level radiation from both natural and man-made sources. This level is called “background radiation” and is not harmful to living things.
- If radioactive materials are utilized in a radiological attack, living things could be exposed to higher than background levels of ionizing radiation that could harm them and contaminate their surroundings.
- The potential harm from radiation may be seen within days or weeks after exposure if the dose is extremely high—for example, [hundreds millions](#) of times higher than normal background levels—or, it may present itself as cancer decades later.
- People can reduce their exposure to this harmful radiation by shielding themselves from its source, taking precautions to prevent unnecessary exposure, removing contaminated dust from their skin and clothing, and cleaning, decontaminating or leaving the area.
- There are effective medical treatments to help counter the harmful health effects of internal radiation contamination.
- Radioactivity decays with time. The “half-life” of many radioactive elements is relatively short, but others with much longer half-lives will present challenges to cleaning-up the areas affected by the attack.

### 3. Types of Incidents We Might Face

What types of radiological threats might we face should radioactive materials be used in a terrorist attack?

Experts have identified four potential scenarios: *(NOTE: some simple graphics depicting these four scenarios could be helpful here—there are some on the REMM website.)*

- **A Radiological Exposure Device, or “RED,”** is a non-explosive device made of highly radioactive material that is hidden in a highly populated area. When people pass by it, they are unknowingly exposed to [potentially](#) harmful levels of radiation.
- **A Radiological Dispersal Device, or “RDD,”** is a device that releases radioactive materials into the environment by using conventional explosives or another method. This device is commonly referred to as a “Dirty Bomb.”

- A targeted **attack on a nuclear power plant or installation** could result in the release of radioactive materials from the nuclear reactor, spent fuel or other nuclear materials stored on site.
- An **Improvised Nuclear Device, or “IND,”** is a crude nuclear bomb, built from scratch or from stolen components, that is capable of producing damage similar to that experienced at Hiroshima or Nagasaki.

The radiation exposures and effects that would result from events such as these vary widely from scenario to scenario, so we will examine each one separately.

### The **Radiological Exposure Device (RED):**

A RED contains highly radioactive materials in a sealed device that is intended to expose people to significant doses of ionizing radiation without their knowledge. Such a device could be hidden in a public place such as in a subway car or sports stadium in order to expose a large number of people. A RED causes exposure to high levels of radiation, but unless the seal around the radioactive materials is broken, it does not cause radioactive contamination. The amount of radiation received is measured in dose. The total dose that would result from exposure to a RED would depend on the type of radioactive material used, how close the person was to the material, and for how long the person was near the device. The adverse health risk~~damage to the body~~ would increase as the dose increases.

### The **Radiological Dispersal Device (RDD):**

A RDD is a device that releases radioactive materials into the environment. It could combine conventional explosives with radioactive materials so that when it is detonated, it volatilizes and disperses radioactive material and other debris into the surrounding area. Or, it could spray radioactive materials into the environment using a mechanical device such as a crop duster. The easiest way to release radiological agents would be to detonate a type of RDD known as a “dirty bomb” [*image—an explosion in a city*]. It is important to realize that a dirty bomb is not the same thing as a nuclear bomb. A dirty bomb uses radioactive materials, but these materials do not undergo the type of nuclear reaction that releases large quantities of energy and produces an atomic mushroom cloud.

The main dangers from a dirty bomb are the serious injuries and damage that would result from the explosion itself. It most likely would not have enough radioactive material to cause serious radiation sickness among large numbers of people. Nonetheless, it would contaminate the immediate area surrounding the explosion with radioactive dust, smoke or other materials that could be dangerous if inhaled and potentially cause long-term contamination and recovery problems. Since it would likely be detonated in a densely populated area, it could cause significant disruption and panic.

*[Need to find or create a video clip to illustrate the dirty bomb scenario. At John Cardarelli's suggestion we are evaluating the potential use of DHS video coverage from TOPOFF 2]*

### **An attack on a nuclear plant or installation:**

Terrorists could release radioactive materials by intentionally causing a fire or explosion at a nuclear power plant or nuclear installation. Such an incident could require evacuation of the geographic area proximate to the facility and cause widespread contamination from both long and short-lived radioisotopes released as a result of the attack.

The world has suffered several accidents at nuclear power plants, including the Chernobyl reactor meltdown in 1986, and partial reactor meltdowns at the Three Mile Island Nuclear Plant near Harrisburg, Pennsylvania in 1979 and the Chalk River Nuclear Plant near Ottawa, Ontario in 1952. Radioactive releases were also caused by a fire at the Windscale reactor near Liverpool, England in 1957 and by an earthquake at a reactor near Kashiwazaki, Japan in 2007. *[Show still images of several of these sites and possibly some of the newspaper headlines that went with these accidents.]*

The worst of these incidents was that at the Chernobyl plant, which we will discuss in more detail shortly. Although a terrorist attack on a U.S. nuclear facility could have serious consequences, it is important to keep in mind that nuclear power plants in the United States are not like those found in the former Soviet Union. The design of U.S. reactors is very different from the design of the Chernobyl reactors, and U.S. nuclear safety and security regulations are more stringent. The technical design of U.S. reactors makes major releases of radioactive materials under any circumstances extremely unlikely, if at all possible.

### **An Improvised Nuclear Device (IND):**

The most devastating way to release radiological agents would be to construct and detonate an Improvised Nuclear Device, or IND. An IND is a small nuclear bomb in which radioactive materials undergo a nuclear reaction and release massive amounts of energy. Explosion of an IND would be devastating and would likely cause mass casualties and major property damage. However, the technical difficulty of obtaining the necessary materials and creating the conditions for a nuclear reaction make this a less likely scenario than a RDD. A stolen nuclear weapon by a terrorist organization is of greater concern.

Although explosion of an IND would be a catastrophic event, its long-term contamination effects could actually be less than those experienced following the Chernobyl accident. The Chernobyl accident resulted in the continuous release of radioactive materials into

the environment over a period of ten days. An IND contains much less radioactive material and releases all of it in an instant. These materials would be spread over less distance compared with Chernobyl, but the area could be highly contaminated. Most of the radioactive materials released by an IND would decay within in the first few months. However, a small amount of residual contamination would remain for a relatively long time. Cesium-137 and Strontium-90 are the two long-lived isotopes common to both Chernobyl and INDs.

To sum up, we face four main types of incidents that might result in the exposure to or release of radioactive materials: a Radiological Exposure Device, a Radiological Dispersal Device, an attack at a nuclear plant or installation, and an Improvised Nuclear Device. *[Could use a simple graphic here.]*

A dirty bomb is a likely scenario. The radioactive materials released would likely remain persistent in the environment for a relatively long time, and may contaminate a populated downtown area.

An attack on a nuclear power plant or installation could release both long- and short-lived radioisotopes that may cause widespread contamination, similar to those released during the Chernobyl incident. The scale of such a disaster is not likely to match the uncontrolled meltdown at Chernobyl, where a fire raged for 10 days, spewing nuclear and radioactive materials into the atmosphere and spreading them over hundreds of thousands of square miles.

Detonation of an improvised nuclear device would be a catastrophic event that could devastate a city and cause widespread destruction. A nuclear bomb would involve a nuclear reaction and release formidable amounts of energy and scatters radioactive fallout over a large region. Most of the types of materials released would decay relatively quickly. However, a small amount of residual contamination would remain for a relatively long time, posing more challenging recovery issues.

#### **4. The Chernobyl Incident and the Initial Response**

Now that we've covered a few of the basics about radiation, radioactivity and the types of emergencies that may occur, we can better examine the issues associated with radiological contamination. The 1986 accident at the Chernobyl power plant in the Soviet Union gives us insight into how we might recover from a wide-scale radiological event. First, let's take a look at the accident itself.

In the early morning hours of April 26, 1986, the Chernobyl nuclear plant experienced the worst nuclear power accident in history. The accident created an uncontrolled nuclear reaction and the resulting explosion and fire sent a massive cloud of radioactive material into the atmosphere. The reactor burned for 10 days, releasing radioactive gases, vapors, aerosols and particles, and contaminating thousands of square miles in Ukraine, Belarus, Russia, and Western Europe. *[Images: nuclear technicians at the plant, the plant on fire, people suiting up to respond.]*

The Chernobyl nuclear plant is located near the border between Russia, Ukraine, and Belarus, about 70 miles northwest of the city of Kiev, the nearest major population center. Kiev had a population of about 2.5 million people at the time of the disaster. The town of Pripyat, located about two miles from the reactor, had a population of about 45,000 people at the time of the accident. *[Image – a map showing the broader geographic area, the plant, Pripyat, and Kiev—there is a good one at [world-nuclear.org/info/chernobyl](http://world-nuclear.org/info/chernobyl).]*

On April 25, 1986, Chernobyl plant personnel began conducting a safety test to determine if the reactor's cooling system pumps could operate if the plant's external power failed. Errors made by the plant operators and deficiencies in the reactor's design and operating procedures caused the reactor to go out of control during the test, resulting in a series of explosions and massive fires. *(References: World Nuclear Association Website, Chernobyl Accident, November 2009; IAEA Safety Series Report 75-INSAG-7, The Chernobyl Accident: Updating of INSAG-1, 1992.)* The reactor core and building burned for 10 days, and radioisotopes were carried upward into the atmosphere where they traveled with the prevailing winds. The accident at Chernobyl released about 400 times more radioactive material into the atmosphere than the bomb dropped on Hiroshima during the second World War. *(Ten Years After Chernobyl: What Do We Really Know?, IAEA, 1996).*

According to reliable reports (*IAEA Consequences of the Chernobyl Accident and their Remediation: Twenty Years of Experience p.21*), winds were initially to the northwest, but they varied over the next several days so that all areas were downwind at some point while the fire in the core continued burning. To further complicate matters, scattered thunderstorms and rainfall throughout the area brought down some of the airborne material to ground level, forming an irregular radioactive fallout pattern over thousands of square miles. *[graphic – figure 3.2 IAEA report, image of fallout pattern IAEA report Fig 3.6 and <http://www.chernobyl.info/index.php?navID=2>]*

The initial response to the disaster was disorganized, improvised, and chaotic. The main priority of the first responders was to put out the fire and then isolate the reactor core. First on the scene were local firefighters and soldiers who were not aware of the grave threat of exposure to very high levels of radioactivity. The firefighters extinguished the fires on the roof of the reactor building and in the surrounding area, thus protecting the other reactors at the Chernobyl facility, but they were not able to put out the burning reactor core. Many of these heroic firefighters and soldiers died from their enormous radiation exposure within days or weeks. *[Image: commemorative statue to lost firefighters in the town of Pripyat.]*

To put out the fire in the core, local authorities tried several approaches, including dropping 5,000 tons of sand, clay, and lead onto the core by helicopter. *[Image: helicopters dropping bags of materials.]* But because of the dangerous conditions and extreme heat, it took workers 10 days to put out the fire.

The town of Pripyat, located 2 miles northwest (and downwind) of the reactor, was evacuated on Sunday, April 27, one and one half days after the accident began. Residents were told to pack for three days and to leave household pets behind. The motivation for giving such a short timeframe for the evacuation was logistical: to limit the amount of baggage and personal belongings to be transported and to expedite the evacuation. A convoy of 1200 buses carried the residents and their belongings away, and the evacuation was reportedly completed in about three hours. *[Images of the evacuation of Pripyat – the long line of buses, lines of people getting on them and so forth.]*

In the following days, authorities measured radiation levels in the areas surrounding Chernobyl to determine the extent of contamination. Radiation levels above background were measured at distances of hundreds of miles away, but the government focused on the most heavily contaminated areas. The Soviet Ministry of Public Health determined that a 30 kilometer (about 19 miles) radius around the plant site would be evacuated.

Isolating the reactor was an immediate priority once the fires were extinguished and the nearby towns were evacuated. To make a safer work zone, the area surrounding the reactor was cleared of debris. The contaminated debris, reactor core fragments, and surface soils from the immediate area around the reactor were placed in a concrete reinforced gallery hastily constructed around the reactor. Removal and shielding of this material made the area safer to work in.

Other soils and debris were stored in a large number of temporary shallow trenches and impoundments within the exclusion zone and covered with soil to provide minimal shielding and to reduce potential for wind to mobilize the contaminants. These trenches and small impoundments were not designed as permanent storage, yet most of them remain to this day. *[Possible image – trenches around Chernobyl or a generic trench and piles of debris to illustrate concept.*

*]*

After ~~the fires were extinguished~~[cleaning the blast area](#), a structure known as the sarcophagus was constructed of concrete, steel plates and beams to isolate the most contaminated wastes and the reactor. The sarcophagus was constructed between May and November 1986 under very hazardous working conditions. *[Images of the Chernobyl sarcophagus.]* The structure was hastily designed and erected and has been exposed to the elements and infiltrated by moisture for more than 20 years. A new safer confinement structure is currently being designed to address the shortcomings of the sarcophagus and to [further](#) isolate the reactor core and the most contaminated wastes for the next 100 years. *[Image: New safe confinement structure image is on cover of IAEA report: Consequences of the Chernobyl Accident and their Remediation: Twenty Years of Experience.]*

## 5. Living in the Aftermath of Chernobyl—Lessons from the Recovery

The accident at Chernobyl resulted in unprecedented radiological contamination of a densely inhabited area. It caused major economic, social and psychological hardships to those living in the region. Local and national authorities were not prepared for an incident of such size and severity. How did people in the region react and what measures did they take to cope after the accident? How did the cleanup of the area proceed and what was life like in the affected areas?

The reports of two women with first-hand, personal experiences living in the aftermath of Chernobyl help to answer these questions. The first is Larisa Leonova, a chemist with the U.S. Environmental Protection Agency who was one of the early responders to the Chernobyl event. At the time of the accident, she was managing a laboratory in Moscow on a part-time basis while earning her PhD in chemistry. Larissa volunteered to help with the response and traveled to Kiev several weeks after the incident. She worked in the area around Pripjat, trying to convince local residents to leave the area.

*[Image – LL8 3:51:54 – 3:52:21 “My Name is Larisa Leanova and I live in United States oh, it’s my twentieth years. And um, back when Chernobyl happened I was ah, twenty-eight years old and four years is graduated from ah, university. And I was working as a chemist, basically part time a lab manager and part time doing my PhD research work. Back when the Chernobyl happened I was in Moscow, I always lived in Moscow.”]*

*[Image—LL8 4:00.44--?? “So, I basically ah, set up the vacation time and I called to my uncle in the Kiev and I said like you know me and another group of ah, chemists we are ready to provide whatever the type of the help we can.”]*

Vira Yakusha is a computer scientist with a consulting firm in Washington DC. At the time of the accident, Vira was a resident of Kiev and a recent graduate of Kiev University. Vira was pregnant with her first child, and she brings the perspective of an expectant mother and member of the general public reacting to the events occurring around her.

*[Image – VY4 2:33:03 – 2:34:00 “My name is Vira Yakusha and ah, I was born in Kiev. And ah, I lived there for my entire life. And I loved the city a lot. And ah, I was there as a just a member of general population when Chernobyl tragedy struck. And so my perspective is a perspective of a lay person who is not professionally involved in the nuclear, in the nuclear industry, but who was, whose*

*life was directly affected by what happened. And ah, my story is a story of person who is trying to comprehend what's going on and trying to do the best, what is best for my family, for health of my family and ah, trying to live my life as ah, as simple as possible if it's possible in the difficult circumstance.”]*

Using the first-hand accounts of Larissa and Vira, we will look at several key aspects of the recovery from a radiological event: countermeasures to reduce exposure to the radiation released during the incident, coping with contamination of the food supply, and the special health concerns for pregnant women and their children associated with the accident.

### **5.1 Limiting Exposure and Cleaning Up**

Once the pressing issues of putting out the fires, evacuating the immediate area, removing debris and isolating the reactor were taken care of, attention turned to the impact of the accident on the broader area. Radioactive dust and dirt were a major source of contamination in both agricultural and urban areas.

Because of the magnitude of the accident, local and national authorities were initially uncertain how to proceed. Larissa Leonova, a chemist who now works for the U.S. EPA, volunteered to travel to Kiev in the first weeks after the accident to lend a hand.

*[LL4:01:56- 4:02:35 “our group of volunteers were basically invited by um, some sort of the organization which were created back there and basically consist um, of very strange group of people who -- represented by Army and by some ah, local officials which were not scientists. They were just the politicians and they were trying, trying to create some sort of the response. And um, again you know first couple of weeks it was basically you know not enough data or no information about plume or no information which territory it's more affected.”]*

*[LL4:03:03 – 4:03:14 “we were among of the first, to my knowledge, volunteer group who went there and who got um, ah, who were involved in ah, um, some sort of the response.”]*

One of the first assignments of the group of volunteers was to provide the local populace with some basic guidance about how to limit their exposure to the radioisotopes released by the plant.

*[LL4:05:05 – 4:05:25 “that's the season when everybody in the Ukraine um, pick up the strawberries. And Ukraine, it's very high in the strawberries and actually you know like um, everybody over there -- middle of the May and June the strawberries is the best place -- taste unbelievably good and everybody has a strawberry growing in their backyards and garden.”]*

*[LY4:05:40 – 4:05:51 “So, the first advice which we wrote was very silly, we’re saying like do not eat the strawberries if they are you know like right besides the dripping line um, from your roof.”]*

*[LL4:06:00 –4:06:15 “The other thing was we were basically advising that ah, try to have at least a bucket of water near the entrance of your door and before -- after you*

*coming from the street to your house, wash you um, shoes and remove your shoes, try to not bring the additional dust.”]*

Once the authorities began to realize the significance of the accident, they began to issue further guidance on ways to reduce exposure to contaminated dust:

*[VY1 01:34:00 - 01:34:30 “First Monday after, uh, after Easter so it was May -- May 5th, and the May 5th was the first day when, uh, when authorities, uh, Soviet authorities officially on the radio started to say well, things are, um, under control, but, um, for, just for personal precautions please shower regularly, try to keep dust out of the rooms, and, uh, keep your clothes laundered often, and cover the food and bread if you buy something so, uh, it’s, uh, to prevent dust from, uh, coming on the food. Uh, so there were first official guidelines for general population to minimize, uh, the exposure.”]*

*VY3 02:25:56 - 02:26:32 “After that first announcement, ah, they say that you should wash ah, take shower often, wash your ah, clothing often. Ah, try to prevent dust from setting on your household items. Ah, there was more information. And ah, it will become more and more detailed and instructions more elaborate this time. Then they were not that afraid to accept or admit that something wrong is going on. And, ah, we were doing this religiously. Our family. We were trying to follow everything and some more.”]*

*VY3 02:14:21- 02:14:18 “my family just tried to keep everything as clean as possible. Free from dust, from dirt. But ah, the thing is that you cannot be 100% sure, of course. And later on, of course, it was not about the surfaces, of your living space, but more about the food that you are getting and ah, and ah, probably some accidental contamination that, for example, like there, rooftops for um, perceived to be very dirty. And they were in fact. So we were told or people were telling the children were told to avoid the downpours from the, from the roof, for example. If ah, water is pouring from the roof, it’s probably, if it goes and fills in your overcoat, you don’t want to have your overcoat to get dirty and to get rid of it later on.”]*

As we can see from these examples, one of the primary ways people are exposed to radioactivity after a radiological event is through contaminated dust and soil that adheres to hair, skin, clothing, and shoes. One effective way to reduce this exposure is to shower frequently, launder clothing frequently, remove shoes and outer clothing before entering living areas, and practice general good housekeeping to reduce dust and dirt indoors.

These hygiene precautions were successful in areas like Kiev after the Chernobyl accident, and they are also recommended by Centers for Disease Control and others.

The decontamination activities performed after Chernobyl gives us an idea of what techniques are most effective to reduce the dose received from exposures to radiation. In the days following the accident, the area around the Chernobyl plant and the most contaminated areas in the exclusion zone were sprayed with organic solutions to create a thin film that would immobilize dust. Buildings, vehicles, and city streets were washed frequently and sprayed with water to suppress dust. *[Image: workers spraying water on trucks, buildings, and streets.]*

Much of the radioactivity from the accident was concentrated in surface soil, plants, on asphalt and concrete, and to a lesser extent on roofs and walls. Streets in Kiev were washed daily in the weeks following the accident. In surrounding areas, roads and buildings were washed, residential areas were cleaned, contaminated soils were removed--especially along drip lines next to buildings--and sediments were removed from the bottom of reservoirs. *[Image: men peeling back sod (42-15785116).]* Decontamination activities concentrated on schools, hospitals and other high-use buildings. Overall, tens of thousands of public buildings and residences were treated in about 1000 cities and towns.

According to the International Atomic Energy Agency (*IAEA Consequences of the Chernobyl Accident and their Remediation: Twenty Years of Experience*), street cleaning, removing trees and shrubs, and plowing soils in yards to bury the surface soils were efficient and inexpensive means of achieving significant reductions of dose. Roofs and walls also contribute to dose, but they are costly and difficult to clean and thus present a more difficult issue in the event of a radiological emergency in an urban setting. *[Images for this section could be a montage of people scrubbing, plowing, and spraying the streets, buildings, and yards.]*

VY4 02:45:17 – 2:45:31 *“I’ve heard from people who stayed there that um, street washing was much more frequent during that memorable summer than there is. When much more often than usual and they were doing a good job of keeping the city clean after all.”*

VY4 2:58:48 – 2:59:05 *“In my understanding and my feeling that ah, in the long term during that summer, during consequent months, government did a lot. I mean what they could at this given time. Given level of technology. To clean up what they could.”*

VY4 02:57:04 – 2:57:12 *“Not really humanly possible ah, to get things 100% clean as they were before. Ah, you had to really invent a time machine for that.”*

VY4 2:57:19 – ? *“For example contaminated soil could be put out of agricultural use. Some things could be thrown away but you cannot make clean everything.”*

*You just, it's impossible. Period. And this what ah, was um, a perception that government did what they could do."*

In 2008, the International Commission on Radiological Protection issued a report that provided guidance on the protection of people living in areas that had been contaminated on a long-term basis from a radiological event. The report identifies numerous actions and strategies that can be used to reduce exposures, improve living conditions and rehabilitate the affected areas. Among the actions identified in the report that should be implemented by authorities are "...clean-up of buildings, remediation of soils and vegetation, changes in animal husbandry, monitoring of the environment and produce, provision of clean foodstuffs, managing of waste..., health surveillance..." and public information. The report also identifies actions that can be taken by the inhabitants of the area, including monitoring the radiological quality of their living areas and food, and the radiation exposure of themselves and their children. (Reference: ICRP Publication 111, October, 2008, page 12.)

The following websites also provide good information on actions that can be taken to limit exposure after a radiological incident. [Images: CDC rad website and address [www.bt.cdc.gov/radiation](http://www.bt.cdc.gov/radiation), image of DHS Ready.gov rad website and address <http://www.ready.gov/america/beinformed/radiation.html>.

There's also a not-so-great quality but understandable image of a silhouette guy showering off yellow dots at <http://www.remm.nlm.gov/deconimage.htm>]

## **5.2 Managing the Food Supply**

The massive amount of radioactive fallout from Chernobyl also had far-reaching consequences for the food supply in the contaminated area. As noted by the International Commission on Radiological Protection, "the management of contaminated foodstuffs and other commodities produced in areas affected by a nuclear accident or a radiation emergency...presents a particularly difficult problem because of issues of market acceptance." (Reference: ICRP Publication 104, 2007.) [While external exposures are likely to dominate radiation doses, internal exposure to radiological contaminants through consumption of contaminated food and water can be a very significant exposure concern.](#) Early responders were advised not to eat locally grown food, and surprisingly, to drink red wine instead of water:

[LL8: 4:20:00 – 4:20:06 "We were ordered -- we were basically -- that was our order to drink red wine, not drink water. So, that was our liquid consumption. "and LY8 04:27:54 – 4:28:08 "We were not given anything besides red wine. We were strictly advised not drink water or milk. And we were advised do not eat any um, grown -- locally grown product -- produce, nothing, no vegetables, no fruit, nothing."]

Many locals used common sense and avoided eating locally grown foods that were probably contaminated:

*[LY8 4:14:29 - 4:14:45 “We found the people who were very educated and um, they were not eating any fresh food since the accident, since the first they heard about the accident. They were trying to eat canned food only.”*

Local authorities prohibited animal feeding with pasture grasses in the affected areas and rejected milk based on radiological monitoring. Many thousands of agricultural and domestic animals were slaughtered immediately, and the remainder evacuated. *[Images – pigs and cows being screened with radioactivity meters by a worker in a moon suit (ex: 42-15882699 and 0000316032-056), images of dead fish on the shore near the reactor(I suggest no using an image of dead fish because their death was not caused by radiation which some may be led to believe by using it in this context. These fish were likely killed due to the contaminated water from efforts to put the fires out – not the radiation in the water.) ]*

People living in the area tried to obtain imported food as much as possible, but this was often difficult. Vira Yakusha explains her dietary habits when she returned to Kiev with a young baby in the months following the accident:

*[VY3 02:27:15 – 2:27:43 Well first concern ah, at that point was the food. And ah, food and again official line was that all food is carefully screened. Sources of food that contaminated milk or other ah, ah, necessities are discarded and thrown away and so you don’t have worry about that. But of course we did worry. And of course we, we will try to buy imported food. As much as it was possible. But it was not that readily available.*

*VY3 2:22:18 – 2:24:00 “...if there is a cereal made in Hungary, probably there is less ah, a less chance that it’s radiologically contaminated than the sour cream made on the local factory. Because God knows where this local factory gets their milk from. And in the first couple of weeks we were so ardent about it that I even didn’t eat any bread because bread was definitely make over, made of local grains. And again, local grains could be contaminated. But after a couple of weeks without bread, I said you know what? I’m going to eat bread. Because I cannot. I need to eat something, right?”*

*[VY3 02:28:35 – 2:28:51 “So there are very, there are always efforts. There are always efforts to make sure your food sources are clear. But it is almost impossible. So you have to accept at some point that you have to, continue with your life or otherwise you will just go mad.”*

*VY3 2:27:43– 2:28:12 “And of course, ah, ah, we will try to buy imported food. As, as much as it was possible. But it was not that readily available. And again, there were um, ah, some things that you cannot buy imported. For example, like your greens, your apples. And ah, sometimes you will come across imported apples with big luck. I remember my husband bought five kilos of ah, ah, a golden ah, golden delicious which is a common brand in America and they were ah, grown somewhere ah, from north of imported apples. And we were very happy. We were feeding our baby these apples for quite a long time while they lasted.”*

According to the International Atomic Energy Agency, some of the most effective countermeasures were treating the soil; removing some areas from agricultural production altogether based on radiological screening; switching animals to clean fodder from uncontaminated areas; and providing dietary supplements such as cesium binders to help the radio nuclides pass through the animals without being incorporated in food products. *[Images: workers in suits walking through a field (42-15800571), a man with a rotor tiller (42-15784775), peasant gardeners (DWF15-682237), and a fallow field with a rad sign in front of it (42-15784775)].*

The countermeasures described above went a long way to reducing the radiological contamination of foods from the areas affected by the Chernobyl accident. However, the long half life of some of the contaminants, particularly Cesium-137, and the economic hardships following the fall of the Soviet Union, resulted in continued barriers to agricultural restoration in the affected area.

### 5.3 Coping with Health Concerns

Exposure of humans to radiation can cause health problems, depending on the type of radiation, the amount of radiation exposure, and the individual's general health and susceptibility to illness. For the people affected by Chernobyl, the potential impact of the accident on their health was a major concern.

Vira Yakusha was living in Kiev and pregnant with her first child at the time of the accident. Upon learning of the disaster, she tried to leave Kiev as soon as she was able, to try to put as much distance between her baby and the radiation emergency as she could. Unfortunately, many people were trying to do the same, and Vira was unable to buy a train or plane ticket *[image –we could show a few generic Russian-looking group queued up at a ticket booth, as Vira spoke about the crush of people waiting to purchase airline or train tickets.]*

Vira discussed this situation urgently with her husband and her family:

*VY1 1:29:20 - 01:29:27 "I was really determined, uh, to keep my baby healthy and, uh, as far as harm's way was possible."*

*VY1 1:50:49 "I don't know what to do, it's impossible to buy tickets for -- for a plane, it's impossible to buy tickets for a train, but we need to get you out. And we were sitting in the kitchen and trying to figure out what kind of plan that could work"*

*VY2 01:51:36 – 1:51:41 "And so we were thinking about this and that, and there is suddenly, um, uh, a buzz on the door ..."*

*VY2 1:51:54 – 1:52:44 "I opened the door and this is, uh, again my friend, uh, Yenna, who, uh, head of the family who were taking me to Karnyov, and he sort of looks grim, and he said you know what, I made a decision, uh, I take my, uh, girls*

*away to Mosc -- I'm taking my girls away to Moscow because I want to get my kids out of here as soon as possible. And his, his thinking was pretty much the same that if the government admits so much that, uh, it's dangerous, then it's really, really dangerous. Yeah, and he said, um, okay, so my car is downstairs, uh, waiting for you, um, my wife and my kids are in the car, and we have still one place left in this car, this is for Vira. If you want to go with us you have 40 minutes to pack yourself."*

*[Images – Possibly a man standing next to an old, Soviet-style car? A family around a table talking about something obviously upsetting or pressing.]*

Vira left Kiev that night, and four months later in Moscow she gave birth to Doreena, a healthy baby girl. We can't say whether getting out of Kiev, about 70 miles from the disaster, in the weeks after the accident helped her give birth to a healthy child. Her child may very well have been fine had she continued to live in Kiev.

*VY1 01:32:46 – 1:33:18 "Doreena, and she is, uh, 21 years old right now, and, uh, I never had any, uh, uh, health problems with her that I should, could attribute to potential exposure. But unfortunately, uh, my understanding of the nature of the whole thing is that you never can, if you have some sort of health problem you can never be 100 percent sure if it was the result of, uh, your exposure to the radioactivity at some point or it's just your particular body type or, uh, other factors that were contributing."*

Reflecting on her actions many years later, Vira feels that she made the right choice given the information that she had:

*VY4 02:42:38 – 2:43:38 "My personal feeling is the health of your children or your child is the first priority, because this is something that you are ultimately responsible for. So I would say what I said to myself. Put as many miles as you can between the source of radiation and yourself and your baby and try to get as much information as much reliable information as you can. And try to... I mean panic is never a good helper or a good advisor. So probably understanding is our best weapon and to know how things work and what is real danger and what is imagined danger. It is a real important difference. And the more you understand, the better your choices are, the better your behavior is. At least you're choosing between least, least possible evils. And ah, it's impossible to be in a perfect world. But in our imperfect world, you have to make your own choices. And it's better to be based on the, on the ways of reason."*

Pregnant women and their unborn babies are particularly vulnerable to the effects of radiation. However, termination of a pregnancy is rarely justified unless the dose absorbed by the pregnant woman or unborn child is [very very](#) high. According to the International Atomic Energy Agency ~~and the Centers for Disease Control~~, the potential

health risks associated with radiation exposure are highest when a baby is in its early stages of development--during weeks 2 through 15 of the pregnancy. Exposure to large doses of radiation during this time could result in severe health effects such as birth defects, stunted growth, and brain damage.

The risks associated with radiation exposure are somewhat lower during the second and third trimesters of pregnancy. During weeks 16 to 25 of a pregnancy, unborn babies exposed to radiation may experience health consequences, but only if the doses of radiation are very very high, such as those large enough to cause radiation sickness in the mother. After the 26th week of pregnancy, the risks to the unborn baby are lowest since the baby's organs have already been formed. Exposure to radiation from any source during pregnancy can cause significant anxiety and fear, and pregnant women should consult with their doctors about their concerns.

More information about the special health concerns associated with exposure to radiation during pregnancy can be found on the Centers for Disease Control Website [Image – CDC web site and fact sheet at <http://www.bt.cdc.gov/radiation/prenatal.asp>

Coping with uncertain future health risks to people of any age is a significant challenge following a radiological incident. Widespread fear after the Chernobyl accident caused many people to attribute their subsequent health problems to the effects of the accident, even though these problems may have developed anyway.

Vira Yakusha helps us understand: [NOTE: *This is based on statements from Vira but we do not have video of it so we have to discuss how best to portray: [\(why don't we have video? I remember this story being taped.\)](#)*

*“It was my best friend, Nadia, and her husband who helped me leave Kiev and took me with them in their car to Moscow because of our concerns about contamination levels following the accident. Nadia and I were classmates at the university. I never in my life met a more energetic, bright and sunny person than Nadia.*

*“On the drive to Moscow, we took a detour—in part to avoid the roadblocks already established on the main roads between Kiev and Moscow, and in part to help Nadia's relatives plant potatoes. The crop from their vegetable patch was a main source of their food in the winter. We ended up on a little field near Kanev city, and Nadia and her husband were planting potatoes. It was a sunny, very bright spring day. We all had this feeling then that the danger was all around us, and the fact that we could not see, smell or feel it made it even more menacing. But I felt that we were out of danger at that moment—we were already far away from Kiev and even further away from Chernobyl, after all. I just feel very uncomfortable that they were working very hard physically while I was just sitting under a shade tree due to my pregnancy.*

*“Only a month later, information that had been previously suppressed became more or less public, and we learned that the wind had moved the invisible cloud*

*of radioactive dust southward, so the idyllic countryside with the potato patch was exactly underneath it. I was never able to get more specific information, and I don't even know if it really exists, but when we learned in 1994 that Nadia had been diagnosed with breast cancer, the thought of that perfect sunny day came to my mind immediately. I don't think there is any way to prove the link scientifically, but in the mind of everyone involved there is no doubt about the "cause and effect" between the exposure and her illness."*

Since the Chernobyl accident, much knowledge has been gained about its effect on the health of the people who were exposed to radioactive contamination in the areas surrounding the plant. Between 2003 and 2006, the World Health Organization (WHO) conducted a series of expert meeting to review all the scientific evidence and evaluate the health impacts of Chernobyl. The WHO expert group reported in April 2006 that the main cancer consequence observed as of that date was the significant increase in thyroid cancer among young people who had lived in the most contaminated areas of Belarus, the Russian Federation and the Ukraine. These cancers occurred primarily among children and adolescents who drank milk contaminated with radioactive iodine immediately after the accident.

The WHO expert group also reported that "The Chernobyl accident led to extensive relocation of people, loss of economic stability, and long-term threats to health in current and possibly future generations...High levels of stress, anxiety and medically unexplained physical symptoms continue to be reported among those affected by the accident...Designation of the affected population as "victims" rather than "survivors" has led to feelings of helplessness and lack of control over their future. This has resulted in excessive health concerns or reckless behavior..."

*(Source: "Health Effects of the Chernobyl Accident and Special Health Care Programmes: Report of the UN Chernobyl Forum Health Expert Group," Editors Burton Bennett, Michael Repacholi and Zhanat Carr, World Health Organization, Geneva, 2006.)*

The WHO expert group concluded overall that "...the large increase in thyroid cancer incidence among those exposed in childhood and adolescence continues; fortunately, few of these have been fatal. In contrast, at this time, no clearly demonstrated increase in the incidence of other cancers can be attributed to radiation exposure from the accident." However, the report went on to note that this did not mean that the longer-term cancer risk of those who were exposed had not increased. Based on the experience of other populations exposed to ionizing radiation, the WHO experts predicted that "...a small increase in the relative risk of cancer is expected, even at the low to moderate doses received" and said that further studies are required to understand the full health effects of the accident. *(Source: Journal of Radiological Protection 26 (2006) 127-140, Cancer consequences of the Chernobyl accident: 20 years on).*

Vira Yakusha shares her thoughts on the question of whether or not she perceives herself more as a "victim" or as a "survivor" of Chernobyl: [NOTE: *This is based on statements*

from Vira but we do not have video of it so we have to discuss how best to portray: [I know we have video of this.](#)

*“The distinction is more like the difference between having a positive versus a negative attitude towards life. Based on my experience and my communications with fellow denizens of Kiev, there is no way to tell exactly who is a victim and who is a survivor. I guess everyone’s attitude fluctuated between those two poles, depending the weather, the mood etc. But I would agree that people with a prevailing “survivor” attitude had better outcomes in fighting the consequences of Chernobyl. It is impossible to know if they have a “survivor” attitude because they are stronger, or if they are stronger because of their “survivor” attitude.” [These were not the same responses she gave during the interview. We can definitely use this statement but I would also like to find the original video response to this question.](#)*

**6.0 What if it happens here?** (NOTE TO KIRK: Please double check the noted video times in this section as I was working from the transcript, not the DVD.)

One of the biggest problems with the Soviet response to the Chernobyl disaster was a lack of credible information about the accident and its effects on the population. Due to the closed nature of Soviet society, Soviet authorities either did not fully understand the severity of the accident, or they intentionally downplayed it.

The first public notice of the accident came on April 27, 1986 from Sweden when workers at the Forsmark Nuclear Power Plant (about 700 miles away) detected elevated levels of radioactivity that were not from local sources. *[image – map showing Forsmark plant on the east central coast of Sweden and Chernobyl/Kiev, perhaps with a scale showing distance between them.]*

Almost a week after the accident, the major Soviet newspapers were still not discussing the ongoing nuclear disaster that was contaminating much of the USSR and Europe. *[Images of soviet newspapers and political figures; some possible footage at [www.encyclomedia.com](http://www.encyclomedia.com), “The Chernobyl Nuclear Disaster,” September 15, 2006.]* Soviet premier Mikhail Gorbachev did not appear on television to discuss the incident until May 14, 1986, several weeks after the event. As a result, citizens were forced to turn to informal news channels, networks of associates and whatever international news they could find on short-wave radios. The lack of reliable information about the accident and its effects created uncertainty, inefficiency and suspicion that the incident was far worse than was being reported.

Larisa Leanova and Vira Yukasha describe the situation.

*(Possible quotes in order of preference here; how many depends on time)*

*[LY8 3:52:26 – 3:53:33 “we didn’t get any information about Chernobyl um, officially — almost like a week after the accident happened. When I first time*

*heard about it — it was the first day ah, first working day basically it was a Monday, I believe it was 27<sup>th</sup> or 28 of the April. I came to work and one of my co-workers told me, “Did you hear the news that BBC’s announcing”? And I said, “No, I basically was very busy this weekend, I didn’t listen to any BBC”. And we all had the habit to listen one of them ah, for a radio station and um, early morning Monday exchange the news. What really was get — what we were getting from the abroad and what was um, broadcast in the Russian radio stations. So, my co-worker told me that he heard that something happen in the Ukraine and Sweden is picking up ah, increased radioactivity levels. And I said, “I haven’t heard of that”. ]*

*[VY1 1:29:29 – 1:29:41 “Because nobody was giving you any, uh, hard information at this point, assumption was that, uh, probably things are much, much worse than officials would tell you. And, uh, so the first week, uh, we were living our life more or less our life as usual.”]*

*[VY1 1:23:21 – 1:23:36 “we were very skeptical about official sources of information per usual, uh, so we turned onto the, uh, Radio Free, uh, uh, what was that, what was commonly called The Voices From Abroad, and, uh, there were several radio stations that they were broadcasting towards the Soviet territory, and one of them was Voice of America, another was Radio Free Europe and one of them was BBC and such. And they were all, um, the Soviet, uh, government tried to jam them, and so you had intelligence or people who were curious about what was going on and wanted to have more information that was officially available, they were trying to find the Voices on the short wave bands.”]*

*[VY2 1:58:10 – 1:58:50 “I am sitting in the back seat of the car, and, uh, our radio is on, and the radio is official so it’s radio and there’s a news report and oh, everything is, uh, contained in Chernobyl, everything is fine, in Kiev there is no danger at all in Kiev, I mean, the population should not worry. And I’m thinking yeah, that’s, it’s an interesting twist because here I am from Kiev, and, uh, I’m too dirty to enter Moscow but in Kiev everything is fine. Yeah, and, um, it was a surreal moment”]*

*VY2 02:05:28 – 2:05:37 “There is a difference between, uh, questioning authorities or expecting answers to a question. So I was, uh, very aware that authorities are not telling the whole truth. But I never expected to, uh, get answers, truthful answers, if — if I would start questioning.”*

Vira later observed:

*“...my personal observations are not at all scientific, but it seems that people who were critical and distrustful of then-Soviet government information had much better chances to avoid the negative consequences of radioactive contamination. My own story is an example of it because I decided to move away from Kiev in order to protect my baby, even when official sources told the population that there was no real danger in the city. I would caution against applying this ‘rule of thumb’ to U.S. realities because, in my opinion, here there are many mechanisms*

*that will allow better and more truthful information to reach the general population in the case of a negative event.” [NOTE: we have to decide how to best include this quote since it is not on video—either tape her saying it or use her voice here?] [I don’t understand why we are missing the video.](#)*

If a similar incident were to happen in the U.S., we can in fact expect a much more open flow of information. Not only would the major news media cover the disaster, but the U.S. Department of Homeland Security, the Centers for Disease Control, the U.S. Environmental Protection Agency and other agencies would post information on what do.

*[VY4 2:41:07 — 2:42:14 “This is such a society where ah, different ah, groups of people have their say. So there is always a balance of forces. And the result of this balance, ah there is a much better possibility that the real information, the scientific information will come out and be available and be widely available and with the internet, it’s, it’s, it’s even, it’s even better now. Because I remember how I was just raking my mind trying to remember what I was taught about levels of radiation. And now I fully expect it to be available, this information to be available on the web. And probably guidelines that I will have from authorities. I will be more willing to trust them and to follow their recommendation, because I um, understand that it’s much more reliable and much more better grounded reality than it used to be on the Soviet. So it’s a different story.”]*

## **6.1 Being Prepared**

The U.S. Environmental Protection Agency works closely with other civilian and military federal agencies as well as state and local governments to develop radiological emergency response plans and procedures. These plans specify how emergency response organizations will work together and what will actually happen during an emergency response operation. In addition to planning activities, EPA provides training and guidance to first responders, and conducts and participates in exercises that simulate radiological emergencies. (Source: *EPA Radiation Website*.)

Jim Mitchell is an On-Scene Coordinator for the U.S. Environmental Protection Agency. On-Scene Coordinators are responsible for coordinating response activities carried out by federal, state and local officials after a significant incident. Jim describes one of their exercises, called TOP OFF, as an example of how the U.S. is preparing at every level for a possible radiological attack:

*[JM6 3:24:05-3:24:37 “...Top Off was an, was an exercise, uh, that took place about four years ago and it took place in Seattle where there was a, uh, a radiological dirty bomb, a device that was set off in Seattle. Now numerous federal, um, uh, the local, you know, the local city was Seattle and also local communities, you know, took part in responding to this exercise. And it was specifically to look at how the federal government, the federal, state and local governments would respond and outline the issues, uh, that were surrounding their response, identify gaps and try to find ways to fill those gaps.”]*

*[JM7 3:42:27 – 3:43:20 “...we’re working towards, um, a level of preparedness that we haven’t seen in the past. An, and, um, you know, as a, as, as a part of the region and as part of our, our, um, uh, response experts, uh, for responding to these types of incidents, we’re working there. Uh, we need to continually develop exercises and training not only from On Scene Coordinators and, and our own responders, both regionally and nationally, but we need to, we need to, uh, to integrate our plans and procedures with the locals, with state and local, um, plans, with other federal agencies. So we clearly have a defined role and we have a, a developed, uh, a working path so if something like this happens, we’re not, you know, we’re not arguing over who’s doing what or who’s responsible for what. That we, that we continue to achieve a level of preparedness, um, you know, everyday. It’s, it’s an ongoing process.”]*

*[JM7 3:43:27 – 3:43:42 “We cannot anticipate all the conditions, um, or the, or the, or the impacts from something like this. We can take the knowledge that we, that we have to develop through exercises, through training, um, through research from our national laboratories and try to bring it to a level of preparedness that we have not seen in the past. And we’re working towards that on a daily basis.”]*

Public education is another essential element in preparing for a possible incident.

*[LV10 4:49:00 – 4:50:56 “...So, my message will be prepare yourself as much as you can, read the literature which is advising you how you have to act in case of the um, pandemic flu, in case of the emergency evacuations, what you have to keep in your home in case of the first couple of days of survival you know like in the case of the accident. Meaning you have to trust your government but you have to trust yourself also because it’s so many of us, it’s only one government. So if you will not help yourself in the very few first moments after the accident your government may be too late when it finally—government will be helping you. So you have to give the government opportunity to save you. And to do that basically educate yourself what you can do for yourself and you know take the responsible action.”]*

Dr. John Cardarelli of the U.S. Environmental Protection Agency discusses some of the information resources available to the public:

*[JC2 5:08:32 - 5:09:42 “There’s a lot of resources available to folks to learn more about long-term recovery and the types of information that they — that’s going to be concerned or they’re going to be interested on. I would recommend a lot of folks visit uh, vetted, scientific, internet websites. Uh, for example, usepa.gov uh, the cdc.gov for public health inquiries, there’s a nice website that’s available by various professional societies, the Health/Physics Society, which is hps.org. Um, the National Commission for Radiological Protection is also another good website uh, the ncrp.com and there’s various international uh, websites as well.*

*I.A.E.A, that stands for the International Atomic Energy Association, as well as*

*the I.C.R.P., the International Commission for Radiological Protection. These are all scientifically valid, vetted information that can provide a lot of information to folks that are concerned about the public health issues, environmental issues and some of the socio-economic aspects of why certain things and clean, cleanup levels have been set the way they have.”]*

*[JC 5:10:00 – 5: 10:36 “You’re going to have a large variety of professional folks, subject matter experts, some who will say, any amount of radiation is not good for you. Others will say, you can take X amount and it’s not going to hurt you at all. The truth probably is somewhere in between and what’s more important is that folks understand that and they have to come to, to a conclusion themselves. The best way to do that is to educate yourself on what the risks are to you, your family, your friends, your loved ones um, and do that by educating yourself at these various websites.”]*

Examples of good internet sites for information on how to respond to a radiological incident are: the Department of Health and Human Services’ Radiation Event Medical Management site [Show a screen shot and the web address: [www.remm.nlm.gov](http://www.remm.nlm.gov)]; U.S. EPA’s Radiation Protection program page [show screen shot and address: [www.epa.gov/radiation](http://www.epa.gov/radiation)]; and the U.S. Department of Homeland Security’s Ready America Radiation Threat site [Screen shot and [www.ready.gov/america/beinformed/radiation.html](http://www.ready.gov/america/beinformed/radiation.html)].

## **7.0 Conclusion**

As frightening as the possibility of a “dirty Bomb” or other radiological incident may seem, we know from experience that we can recover safely from such an event. And, the United States is better prepared than ever before to cope with such an eventuality.

In this film, we have reviewed the incident at the Chernobyl power plant—the worst nuclear accident in history and which released much more radiation than would be expected from a dirty bomb or radiological attack. We learned that there are many effective ways to limit the exposure of people to radiation and live safely in long-term contaminated areas.

Let’s recap the main points:

- Although we can forecast the potential types of radiological threats might we face, we cannot forecast with precision the exact facts that will accompany any specific incident. However, a dirty bomb or other radiological attack is not likely to release nearly as much radiation as was released from the Chernobyl accident.
- If radioactive materials are used in a terrorist attack, living things could be exposed to higher than normal levels of radiation that could harm them and contaminate their surroundings.

- Exposure to radiation can cause health problems. The possible health risks vary widely depending on the type of radiation, the amount of exposure and the individual's general health.
- Pregnant women should recognize that exposure to small doses of radiation during pregnancy is not likely to increase the risk of birth defects. However, each situation must be evaluated carefully and people with special health concerns should seek advice from their doctor.
- A radiological incident will cause real fear and anxiety among people in the affected area. Being prepared and relying on sound, accurate scientific information can help people to make better-informed decisions and allay these fears.
- People can reduce their exposure to harmful radiation by shielding themselves from the source, removing contaminated dust from their skin and clothing, and cleaning or temporarily leaving the area.
- Governmental authorities can employ a number of effective counter measures after a release, including cleaning-up buildings, remediating soils and vegetation, monitoring the environment and establishing health surveillance programs. They also play an important role in restoring supplies of safe water and food to those in the affected area.
- Radioactivity decays with time. The "half-life" of many radioactive elements is relatively short, but others with much longer half-lives will cause areas to remain contaminated on a long-term basis. Even though such areas may have a higher than background level of radiation, they can be cleaned to a level that allows people to live in them safely.
- Recovering from a large-scale radiological incident may require long periods of time to heal the environment, repair damage to the local economy and mitigate the psychosocial impacts on the population.
- There are many high quality sources of public information about the health, environmental and socio-economic issues associated with radiation exposure. If a radiological emergency were to occur in the United States, government and news sources would provide additional information to guide those being affected.

We have learned much about how to cope and recover from a major radiological release since the Chernobyl accident. This knowledge will help us to effectively respond to a future possible incident. The best way for citizens to prepare is to educate themselves about the possible scenarios that could occur and the risks they pose. We hope this film has helped you begin this process.

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